Sand Creek (20)
(see under tungsten)

Schenk
(see Rightside under copper)

Short Wait (1)
(see under lead)

Sierra Zinc (6)
(see under zinc)

Stockwell
(see Columbia Tungsten under tungsten)

Tungsten King (16)
(see under tungsten)

Washington Metals (12)
(see under tungsten)

Western Molybdenum
(see Juno-Echo under copper)

Yo Tambien
(see New Leadville under lead)

WHATCOM COUNTY

Castleman

Loc: Mt. Baker dist. **Ore:** Molybdenum. **Prod:** Produced in 1898. **Ref:** 43, vol. 68, 1899, p. 800. 97, 1899, p. 307. 141, p. 96. **Note:** Division of Mines and Geology could not verify this reported occurrence.

Midas (1)

Loc: Sec. 25, (40-9E), Mt. Baker dist. **Owner:** J. A. Nesbitt and John and David Cress, Bellingham, Wash. (1949). **Ore:** Molybdenum. **Deposit:** Owners reported showings too small to be of interest. **Ref:** 68, p. 13.

Shuksan
(see Sulphide Creek)

Silver Creek (2)

Loc: S½ sec. 8, (40-13E), on Silver Cr., 2 mi. S. of Canadian boundary. **Elev:** 2,200 ft. **Access:** Boat up Ruby Lk., thence by trail up Silver Cr., or by road through Canada to mouth of Silver Cr. **Prop:** 4 claims, including Molybdenum, Lost Mine. **Owner:** Roy Davis, George Hunt, A. E. Blockberger, Shelton, Wash. (1950). H. B. Davis and Dr. Harry Deegan, Shelton, Wash. (1939). **Ore:** Molybdenum, copper, gold, silver. **Ore min:** Molybdenite, chalcopyrite. **Deposit:** On S. side of Silver Cr. in granodiorite near contact with volcanic rock is zone 10 ft. wide containing ¼- to 1-in. quartz stringers with scattered chalcopyrite and clusters of molybdenite. On N. side of creek an open cut and an adit 64 ft. lower show a bleached and silicified zone in volcanic breccia 50 ft. in dia. containing scattered molybdenite and chalcopyrite. **Dev:** 85-ft. adit, open cuts. **Assays:** Chip sample of zone at face of adit showed Au nil, Ag 0.40 oz., Cu 1.50%, molybdenite 0.15%. In open cut 64 ft. higher the ore is est. to carry 1% molybdenite and 2% to 3% Cu. **Ref:** 133-B, pp. 87-88. 158.

Sulphide Creek (Shuksan) (3)

Loc: At head of N. Fk. of Sulphide Cr., on E. side of Mt. Shuksan. **Owner:** Charles Bagnell and Robert Johnson, Concrete, Wash. Joe Morovitz (1916). Mount Shuksan Molybdenite Mine and Milling Co. (1917). **Ore:** Molybdenum. **Ore min:** Molybdenite. **Gangue:** Quartz. **Deposit:** Veins up to 1 in. thick, also as films along joints. **Assays:** Reported to be of no economic value. **Ref:** 158.

YAKIMA COUNTY

Bird (2)
(see under tungsten)

Chinook (1)
(see under copper)

Copper Mining Co. (3)
(see under copper)

Crosetti (4)

Loc: Sec. 21, (15-12E), Bumping Lk. dist. **Ore:** Molybdenum. **Ore min:** Molybdenite. **Deposit:** Very slight molybdenite mineralization along joints in aplite stringers in granodiorite. **Ref:** 158.

NICKEL

Properties—Nickel is a lustrous white metal capable of taking a high and lasting polish. It is harder than iron and is tenacious and very malleable and ductile. It is somewhat magnetic and is a fair conductor of heat and electricity, its electrical conductivity being about one-fifth that of copper. Nickel imparts to its alloys toughness and strength as well as desirable anticorrosion and thermal properties. Chemically, it is closely allied with cobalt and iron. Nickel has valences of 2 and 3, but in most of its compounds it is bivalent. The metal is stable in air at ordinary temperatures. Other properties are shown in the table on page 12.

Uses—Although the pure metal is used for electroplating, nickel is chiefly valuable for the alloys it forms with other metals. Over 3,000 alloys of nickel with iron and copper have been developed. Other metals with which it has been alloyed are silver, zinc, tin, beryllium, magnesium, aluminum, and cobalt. The steel and iron industry used about 43 percent of the nickel consumed in the United States in 1950. The leading uses in their order of importance were for nonferrous alloys, stainless steel, electroplating, other steels, high-temperature and electrical-resistance alloys, cast iron, catalysts in hydrogenating organic substances, and ceramics. Minor uses are in coinage, in Edison alkaline storage batteries, and in pharmaceuticals and dyes.

Production—There are few nickel smelters in the world, and most of them do little, if any, custom smelting. Although the United States accounts for more than half of the world nickel consumption, domestic production of the metal amounts to less than 1 percent of that of the world. About 80 to 85 percent of the world production normally comes from Canada. The small domestic output in 1950 was in the form of nickel sulfate and came entirely as a byproduct of copper smelting from five smelters, one of which was the copper smelter of the American Smelting and Refining Company, at Tacoma, Washington.

Although nickel occurrences have been reported in at least 13 counties in Washington, no ore has ever been mined for its nickel content in this state. Some of the lateritic deposits in the Cle Elum River-Blewett area in Kittitas and Chelan Counties are of sufficient size and

grade to indicate a potential value as ores of nickel, especially in view of the development of the Riddle, Oregon, deposit (somewhat similar metallurgically), where three electric furnaces in 1954 started production of nickel from local ore.

Prices—For many years the price of nickel has been comparatively stable. From 1929 to 1944 the price was 35 cents per pound for the metal, and from 1944 to 1946 it was 31½ cents per pound, including duty, for electrolytic nickel in carlots, f.o.b. Port Colborne, Ontario. In 1946 the price rose to 36 cents and remained there for more than a year, but it dropped a little to 33¾ cents in 1948 and rose to 40 cents in the same year. The price remained the same until two rises in 1950 brought it to 50½ cents and further rises in 1951 brought the price to 56½ cents, where it remained through the following year. In June 1955 the price was 64½ cents per pound.

Ore minerals—Nickel occurs native in meteorites and is combined with sulfur, arsenic, iron, and antimony in many ores. At least 35 nickel minerals are known. The most important nickel ores are nickeliferous pyrrhotite and chalcopyrite, containing up to 6 percent nickel, usually in the form of minute particles of pentlandite, (Fe,Ni)S, which contains about 22 percent nickel. Another nickel sulfide is millerite, NiS, containing 64.7 percent nickel. Garnierite, another important ore mineral, is a hydrated silicate of magnesium and nickel having an extremely variable composition. All these above-named minerals occur in Washington in addition to the secondary hydrous nickel sulfate, morenosite, $NiSO_4 \cdot 7H_2O$.

The important ores of Sudbury, Canada, average about 1½ percent nickel and 2 percent copper. The New Caledonian silicate ores run from 2 to 6 percent, and 1940 production averaged 3.8 percent nickel. Cuban laterites, similar to the Cle Elum River-Blewett ores, comprise large ore bodies averaging 0.8 to 1.5 percent nickel and 1 to 2 percent chromium.

Geology—There are relatively few workable deposits of nickel in the world, because, although nickel is more abundant in the earth's crust than copper, zinc, or lead, it generally is not concentrated but is widely and diffusely distributed, especially in magnesium-rich rocks. There are only two important types of nickel deposits—residual nickel silicate concentrations from the weathering of nickel-bearing ultrabasic rocks, and sulfide deposits of nickel and copper formed either by replacement or magnetic injection. The Sudbury deposit is of the latter type. It contains pentlandite closely associated with pyrrhotite and chalcopyrite in the outer, basic, edge of a large spoon-shaped intrusive body of norite-micropegmatite 36 miles long and 20 miles wide. Of much less importance as a source of nickel are the silver-cobalt-nickel vein deposits such as those at Cobalt, Ontario.

Occurrences

The map showing the numbered nickel occurrences is plate 5, on page 15 in volume 2.

CHELAN COUNTY

Black Republican
(see under copper)

Blewett (24)
(see under iron)

Bonanza and Deadwood
(see under gold)

Chelan
(see Dick)

Cinnabar King
(see under gold)

Davenport
(see Nigger Creek under iron)

Deadwood
(see Bonanza and Deadwood under gold)

Dick (Chelan, Winesap) (6)

Loc: S½NE¼ sec. 9, (26-21E), on a northward-trending spur on the N. side of Winesap (Oklahoma) Canyon. **Elev:** 1,400 ft. **Access:** 0.9 mi. by road from railroad and highway U. S. 97. **Prop:** 80 acres of deeded property. **Owner:** E. N. Patty, Seattle, Wash., leasing from Mrs. Hazel E. Growden and associates, Yakima, Wash. (1942-1946). Condi Dick (1898). **Ore:** Nickel, cobalt, copper. **Ore min:** Pyrrhotite, pentlandite, chalcopyrite, pyrite, malachite, nickel sulfate. **Gangue:** Peridotite. **Deposit:** Body of peridotite about 400 ft. long and 100 ft. wide, enclosed in quartz diorite and gneiss, contains disseminated primary and secondary ore minerals. Oxidation zone extends to 40-ft. depth. **Dev:** 4 adits, two 50 ft. and one 80 ft. in length, also some trenching, and 7 diamond drill holes by U. S. Bureau of Mines totaling 1,016 ft. **Assays:** 2 assays showed 0.03% Co. Av. assay from 80-ft. adit gave 1.5% Ni and 0.3% Cu. A gossan above the No. 3 adit assayed 0.5% Ni. **Reserves:** Est. 30,000 tons of 0.6% to 1.7% Ni and up to 0.7% Cu. **Ref: 35. 67,** pp. 25-26. **131. 158.**

Ellen
(see Van Epps under antimony)

Excelsior
(see Nevada and Excelsior under gold)

Garnierite (20)

Loc: Sec. 24, (23-17E) and sec. 19, (23-18E). **Prop:** 9 claims. **Owner:** Leased to Harry J. Hood, Detroit, Mich. (1943). **Ore:** Nickel. **Ore min:** Garnierite. **Gangue:** Silica-carbonate rock. **Deposit:** "Nickel ledge" in serpentine. **Dev:** 110-ft. adit. **Assays:** 10 samples at 10-ft. intervals along the adit showed 0.09% to 0.20% Ni and had an av. of 0.143% Ni. **Ref: 157. 158.**

Goman (5)

Loc: SW¼ sec. 6, (26-21E), on a ridge near head of Winesap (Oklahoma) Canyon. **Access:** About 4 mi. of county road up Winesap Canyon from highway U. S. 97. **Owner:** George Goman, Winesap, Wash. (1942). **Ore:** Nickel. **Deposit:** Dike or segregational mass of ultrabasic rock in Swakane gneiss. **Dev:** None. **Assays:** Qualitative tests gave moderately strong reactions for nickel. **Ref: 67,** p. 26. **158.**

Gordon (25)
(see under gold)

Hardcash (8)

Loc: Sec. 25, (23-15E), near Mt. Stuart. **Prop:** 2 claims: Hardcash Nos. 1 and 2. **Owner:** C. L. Waite and Carl Anderson,

Tacoma, Wash. (1936). **Ore:** Nickel, chromium. **Assays:** Reportedly 2% Ni, 3.75% Cr. **Ref: 158.**

Holden (3)
(see under copper)

Howe Sound
(see Holden under copper)

Irene
(see Holden under copper)

Keefer Brothers (4)
(see under molybdenum)

King Solomon
(see Van Epps under antimony)

Meridian (12)
(see under gold)

Monarch (18)
(see under gold)

Nevada and Excelsior
(see under gold)

New York (17)
(see under gold)

Nickel Plate
(see under gold)

Nigger Creek (26)
(see under iron)

North Pole (11)
(see under gold)

Ontario (16)
(see under gold)

P. P. Nickel (13)
(see under gold)

Peshastin (23)

Loc: SW¼SW¼ sec. 1, (22-17E), on hillside just W. of old town of Blewett. **Prop:** 1 claim. **Owner:** J. B. Woodworth, Vancouver, B. C. (1949). **Ore:** Nickel. **Ore min:** Green stain. **Gangue:** Quartz, calcite, magnesite. **Deposit:** "Nickel ledge" rock 200 to 800 ft. wide. **Dev:** 250-ft. adit. **Ref: 158.**

Peshastin Creek (21)

Loc: SW¼ sec. 19, (23-18E). **Access:** ½ mi. up Peshastin Cr. road from Blewett Pass highway. **Owner:** Washington Nickel Mining & Alloys Co. (1943). **Ore:** Nickel. **Ore min:** Reportedly garnierite. **Gangue:** Chalcedonic quartz, carbonates. **Deposit:** "Nickel ledge" rock about 150 to 200 ft. wide traceable for a distance of nearly 2 mi. **Dev:** 125-ft adit. **Assays:** Said to av. 1% to 2% Ni. **Ref: 158.**

Rainier (10)
(see under gold)

Red Butte (19)
(see under gold)

Red Cloud and Tralee
(see under copper)

Sevenmile Creek (3A)
(see under antimony)

Shoshone (9)
(see under mercury)

Snook and Ellen
(see Van Epps under antimony)

Stephens (22)

Loc: Secs. 19 and 20, (23-18E). **Owner:** James Stephens, Seattle, Wash. (1942). **Ore:** Nickel. **Ref: 158.**

Tralee
(see Red Cloud and Tralee under copper)

Van Epps (7)
(see under antimony)

Velma (14)
(see under mercury)

War Eagle (15)
(see under gold)

Washington Nickel
(see Blewett under iron)

Winesap
(see Dick)

CLARK COUNTY

Silver Star (1)
(see under copper)

FERRY COUNTY

Big Four

Loc: 6 mi. SW. of Republic. **Ore:** Nickel. **Ref: 100,** 5/03, p. 101.

Congress (4)

Loc: W½SE¼ sec. 35, (32-33E), on Bridge Cr. **Elev:** 2,700 to 2,900 ft. **Access:** 4 mi. by dirt road E. of Sanpoil highway (State No. 4). 40 mi. by road to railroad at Wilbur. **Prop:** 4 patented and 2 unpatented claims. **Owner:** George Wilson, Wilbur, Wash., and Frank Hines, Keller, Wash. (1942). Congress Gold & Copper Mining Co. (1907). Great Northern Mining Co. (1915, 1918-1924). **Ore:** Nickel, cobalt, copper, silver, gold. **Ore min:** Nickeliferous pyrite, chalcopyrite, malachite, nickel carbonate, limonite. **Gangue:** Quartz, dolomite, barite, epidote. **Deposit:** Ore body 35 to 40 ft. wide along a shear zone in serpentine at contact with schist. Zone is mineralized by quartz, dolomite, pyrite, and chalcopyrite. **Dev:** 1,800 to 2,000 ft. of workings on 3 adit levels expose the deposit to depth of 300 ft. below outcrop. **Assays:** 0.17% to 5.17% Ni, 0.013% to 0.35% Co. Av. said to be about 0.53% Ni, 0.02% Co. Sample showed 5.5 oz. Ag and tr. Au. **Ref: 7,** pp. 182-185. **28,** pp. 52-56. **33,** 1907, p. 495. **98,** 1918, p. 71; 1925, p. 1818. **105,** 1/20/12, pp. 144-145. **112,** p. 181. **122,** pp. 134-136. **130,** p. 84. **141,** pp. 99-101. **157. 158.**

Iron Creek
(see Shamrock)

McJunkin (3)
(see under silver)

Pin Money (1)
(see under gold)

Shamrock (Iron Creek) (5)

Loc: Sec. 2, (30-33E) and secs. 26, 27, 34, and 35, (31-33E), 12½ mi. NE. of Keller. **Elev:** 2,000 ft. **Access:** 4 mi. by mountain road and 26 mi. by paved highway to railroad at Republic, and same distance to railroad at Wilbur. **Prop:** 10 claims. **Owner:** H. R. Taylor, Elberton, Wash., (6 claims) and J. M. Walker, Keller, Wash. (4 claims) (1942-1946). Charles Hill and Edward Hall (1902). Iron Creek Mining Co. (1915-1928). Shamrock Silver-Lead Mines, Inc. (1928-1942). **Ore:** Nickel, gold, silver, lead, zinc, copper. **Ore min:** Galena,

malachite, cerussite, lead oxide. **Gangue:** Limestone. **Deposit:** Silicified limestone surrounded by granodiorite. Silver-lead ore is 8 in. to 8 ft. wide and 700 ft. long. Nickel occurs in a mineralized zone 100 ft. wide in which there is a high-grade zone 55 ft. wide. **Dev:** More than 4,000 ft. of underground workings. **Assays:** Sample across 55-ft. width showed 0.7% Ni, and selected samples gave as much as 3.28% Ni. A 43-ton carload gave 7.7% Zn, 11.3% Pb, 0.035 oz. Au, and 51 oz. Ag. **Prod:** 1914 (50 tons), 1922 (3,500 oz. Ag), 1926. **Ref: 46,** p. 157. **97,** 1922, 1924, 1926, 1929, 1930. **98,** 1920-1926. **104,** 9/15/35, p. 23; 11/15/35, p. 24; 1/30/37, p. 28. **105,** 3/22, p. 381. **106,** no. 9, 1921, p. 3; 5/21/31; 11/5/31. **112,** p. 184. **113,** 1/21/37, p. 7. **122,** p. 139. **129,** pp. 218-219. **141,** p. 22. **158.**

Sherman Creek (2)
Loc: SE¼ sec. 25, (36-36E), Sherman Cr. dist. **Ore:** Nickel. **Ref: 158.**

KITTITAS COUNTY

Balfour Guthrie
(see Cle Elum River under iron)

Bean Creek (11)
(see under iron)

Blue Bonnet (2)
(see under copper)

Cle Elum River, north deposit (1)
(see under iron)

Cle Elum River, south deposit (4)
(see under iron)

Denney (5)
(see under chromium)

Devine
(see under iron)

Grandview (8)
(see under copper)

Iron Peak (9)
(see under iron)

Keystone (6)
(see under mercury)

Lost
(see Grandview under copper)

Red Rock (13)
Loc: NW¼NW¼ sec. 20, (19-15E), on N. Fk. of Taneum Cr. **Access:** 3½ mi. by trail up N. Fk. from Taneum Cr. road. **Prop:** 6 claims. **Owner:** R. H. Turton (1942). **Ore:** Nickel, chromium. **Gangue:** Silica-carbonate rock. **Deposit:** "Nickel ledge" rock 100 to 150 ft. wide in graphite schist and overlain by continental sediments. **Dev:** 2 adits, some open cuts. **Ref: 158.**

Stafford Creek (12)
(see under iron)

Teanaway (3)
Loc: NW¼ sec. 16, (23-15E). **Access:** 1½ mi. by trail from N. Fk. of Teanaway R. road. **Ore:** Nickel, copper. **Ore min:** Pyrrhotite, chalcopyrite. **Dev:** Caved adit. **Ref: 158.**

Teanaway (10)
(see under iron)

LEWIS COUNTY

Cowlitz River
Loc: Near head of Cowlitz R. **Ore:** Nickel reported. **Ref: 43,** 8/29/96, p. 20, or p. 207. **130,** p. 84.

Summit Creek (2)
Loc: Near head of Summit Cr. where Summit Cr. trail forks, one branch leading to Carlton Pass, the other to Cowlitz Pass. Probably in N½ sec. 14, (14-10E). **Ore:** Nickel. **Ore min:** Nickel sulfide. **Deposit:** Said to be a 2-in. vein of nickel sulfide exposed in the trail. **Ref: 158.**

MASON COUNTY

Black and White (1)
(see under copper)

OKANOGAN COUNTY

Alta Lake (6)
Loc: NW¼ sec. 22, (29-23E), ¾ mi. S. of Alta Lk. **Elev:** 600 ft. above valley floor. **Owner:** Forrest Wooten, Azwell, Wash. (1951). **Ore:** Nickel, copper. **Ore min:** Pyrrhotite, chalcopyrite. **Gangue:** Silicified gneiss. **Deposit:** 2- to 4-ft. shear zone in schist and gneiss. **Dev:** 66-ft. adit. **Assays:** 1.48% Ni, 0.41% Cu, nil Au, nil Ag. **Ref: 158.**

Brown Lake (3)
Loc: SW¼ sec. 6, (34-26E), in small gullies about ¼ mi. NE. of ranch house. **Ore:** Nickel. **Ore min:** Nickel-bearing sulfide. **Gangue:** Ultrabasic rock. **Ref: 158.**

Cabin
(see Stepstone)

Idell (8)
(see also Stepstone)
Loc: NE¼ sec. 6, (32-31E). **Access:** 2.8 mi. up Stepstone Cr. road from Park City road. **Prop:** 3 claims: Idell Nos. 1 to 3. **Owner:** Mrs. Mamie Bowman owns one or all of these claims (1943). **Ore:** Nickel. **Ore min:** Genthite (?). **Deposit:** Small ramifying quartz veinlets cutting argillite and serpentine. Both vein and wall rocks are slightly nickel stained. **Dev:** Several open pits. **Ref: 122,** p. 85.

Johnson Creek (4)
Loc: NE¼ sec. 5, (34-26E), about 150 ft. NE. of Johnson Cr. road. **Ore:** Nickel. **Ore min:** White sulfide. **Gangue:** Ultrabasic rock. **Ref: 158.**

Jumbo (9)
(see under chromium)

Lilman (11)
(see under silver)

Malott (5)
(see under copper)

Section Twelve (7)
Loc: NE¼ sec. 12, (32-30E). **Access:** 8 mi. N. of Nespelem by road. **Ore:** Nickel. **Ore min:** Genthite. **Gangue:** Quartz, calcite, tremolite. **Deposit:** A slightly crushed quartz lode 4 ft. wide, seams of which are coated with genthite. Wall rock also nickel stained. **Dev:** Small pit. **Ref: 122,** p. 85.

Stepstone (Cabin) (10)
(see also Idell, also Jumbo under chromium)
Loc: Near center N. line sec. 5, (32-31E), Nespelem dist. **Access:** 2.8 mi. up Stepstone Cr. road from Park City road. 29 mi. by road to railroad at Grand Coulee. **Prop:** 3 claims: Cabin, Jumbo, Idell. **Owner:** Mrs. Mamie Bowman and Frank

Funkhauser, Spokane, Wash. (1949). **Ore:** Nickel, chromium. **Ore min:** Chromite, fuchsite, pyrite, pyrrhotite, genthite, zaratite, pentlandite. **Gangue:** Quartz. **Deposit:** 6-ft. bed of limestone and 15-ft. body of serpentine enclosed in quartzite and argillite. Quartz lenses in limestone 1 to 12 in. wide are mineralized. Pyrite, pyrrhotite, and chromite disseminated in serpentine. **Dev:** 2 shafts, one 60 the other 35 ft. deep, and an open cut. **Assays:** A weighted av. of 3 channel samples, each 5 ft. long, from the inclined shaft shows 1.22% Ni, 2.97% Cr_2O_3. An assay on a quartz lens showed 1.56% Ni. A specimen of unoxidized ore from the dump assayed 2.65% Ni. **Ref: 122,** p. 84. **141,** p. 101. **157. 158.**

Wolverine (2)
(see under gold)

PEND OREILLE COUNTY

Grandview (Reuther) (1)
(see under silver)

Reuther
(see Grandview under silver)

SKAGIT COUNTY

Alvard (16)

Loc: N½NE¼ sec. 21, (36-11E), between the highway and railroad. **Access:** About 4 mi. N. of Marblemount by road. **Owner:** Reportedly leased by Skagit Talc, Inc. (1949). **Ore:** Nickel. **Ore min:** Pyrrhotite, green stain. **Gangue:** Talc, ankerite. **Deposit:** Disseminated metallic minerals and some nickel (?) staining occur in a body of soapstone in a shear zone in metamorphic rocks; also some silica-carbonate rock nearby. **Dev:** Several branch adits driven from a quarry face. **Ref: 158.**

Alverson (2)

Loc: NW¼SE¼ sec. 2, (33-2E), about 300 ft. W. of the Alverson strontium deposit. **Access:** Road and trail or accessible by boat. **Ore:** Nickel, arsenic. **Ore min:** Realgar, nickel stain, pyrite, arsenopyrite. **Gangue:** Quartz, carbonates. **Deposit:** Fractured siliceous zone in schist. **Assays:** A 2-ft. sample assayed 0.13% Ni. **Ref: 158.**

Bingham (15)

Loc: S. of Rockport, across Skagit R., possibly in sec. 36, (35-9E). **Owner:** Chas. Bingham, Sedro Woolley, Wash. (1943). **Ore:** Nickel. **Ore min:** Nickel silicate. **Ref: 158.**

Boschert
(see Stephens)

Cavanaugh Lake (13)

Loc: Sec. 31, (33-7E), E. of Cavanaugh Lk. **Ore:** Nickel. **Ore min:** Nickel silicate. **Ref: 158.**

Clear Lake (7)

Loc: In road cut 1½ mi. E. of Clear Lk., secs. 5 and 6, (34-5E). **Ore:** Nickel. **Gangue:** Magnesium carbonate-silicate rock. **Assays:** 0.2% Ni. **Ref: 158.**

Cultus Mountain (9)

Loc: Along the S. line of SE¼ sec. 22, (34-5E), on SW. side of Cultus Mtn. **Ore:** Nickel, chromium. **Ore min:** Pyrite, green stains, realgar, orpiment. **Gangue:** Quartz, diopside, carbonates. **Deposit:** Zones of green-stained silica-carbonate rock in contorted graphite schist. Total distance across the zones is 500 to 800 ft. Exposed length about 2,000 ft. **Ref: 158.**

Cultus Mountain (Stephens)
(see Stephens)

Devils Mountain
(see Mount Vernon)

Diobsud Creek (Germaine)

Loc: Reportedly 1½ mi. N. of Diobsud Cr., Marblemount area. **Access:** Trail, **Prop:** 2 claims. **Owner.** Mr. Germaine (1934). **Ore:** Nickel. **Deposit:** Sample of nickel-stained green limestone said to have come from above location. **Assays:** Said to assay $4.00 Ni. **Ref: 158.**

Finney Creek (14)

Loc: Center T. 34 N., R. 8 E., at headwaters of Finney Cr. **Ore:** Nickel. **Ref: 158.**

George Scott (4)

Loc: Sec. 27, (36-5E). **Owner:** George Scott, Mount Vernon, Wash. (1943). **Ore:** Nickel. **Ore min:** Nickel silicates. **Ref: 158.**

Germaine
(see Diobsud Creek)

Jordan Creek (18)

Loc: NE¼ sec. 19 and SE¼ sec. 29, (35-11E), on N. slope of the mountain W. of Jordan. **Access:** Logging road. **Prop:** Deeded land. **Owner:** Bingham Timber Co. (1943). **Ore:** Nickel. **Ore min:** Nickel stain. **Deposit:** Rock similar to the silica-carbonate rock found SE. of Mount Vernon. Mixed green and brown alteration colors. Occurs in graphitic shale. One outcrop 60 ft. wide. **Dev:** Road cuts. **Ref: 158.**

La Conner (1)

Loc: SE¼ sec. 35, (34-2E), on W. side of Swinomish Slough about ½ mi. S. of Tesi Point road. **Access:** 1 mi. by road from La Conner. **Ore:** Nickel, mercury. **Ore min:** Cinnabar. **Deposit:** Zone of green-stained silica-carbonate rock exposed in a bluff is associated with schist. **Assays:** A 4-ft. sample assayed 0.17% Ni. **Ref: 158.**

McMyrl-Wilson (17)

Loc: NE¼ sec. 21, (36-11E), 100 ft. W. of highway. **Access:** 4 mi. by road from Marblemount. **Ore:** Nickel. **Ore min:** Nickel stain. **Deposit:** Silica-carbonate rock cutting soapstone deposit shows nickel staining. **Dev:** Adit. **Ref: 158.**

Mt. Josephine (3)

Loc: Sec. 5, (36-6E), 1 mi. S. of Mt. Josephine Lookout. **Ore:** Nickel. **Ore min:** Nickel silicate, nickeliferous pyrite. **Ref: 158.**

Mount Vernon (Devils Mountain, Pacific) (12)

Loc: S½ sec. 4, NE¼ sec. 9, N½ sec. 10, and NW¼ sec. 11, (33-4E), on Devils Mtn. **Elev:** 250 to 1,750 ft. **Access:** 4½ mi. SE. of Mount Vernon by road. 1½ mi. by road from railroad. **Prop:** 2,100 acres. **Owner:** Pacific Nickel Co. (1941-1943). **Ore:** Nickel, gold. **Ore min:** Chromite, free gold, nickeliferous ankerite, marcasite, pyrite, bravoite. **Gangue:** Quartz, chalcedony, carbonates. **Deposit:** Fault zone between serpentine and sandstone is made up of silica-carbonate rock with a central zone of sufide-bearing breccia. Silica-carbonate rock portion is 2 mi. long and 100 to 400 ft. wide. Sulfide breccia is in small lenses along the central zone. More than 50,000,000 tons of silica-carbonate rock, of which more than 15,000,000 tons was explored by drilling and found to contain some sulfide-bearing breccia (15,000 to 50,000 tons) that av. more than 0.2% Ni and about 0.02 oz. Au. **Dev:** 300 ft. of adits and 6,375 ft. of diamond drilling. **Assays:** 157 assays on 2,598 ft. of core av. 0.0195 oz. Au, 0.251% Ni. Weighted av. of 74 assays of 600 ft. of trench samples is 0.293% Ni. **Prod:** Test shipments only. **Ref: 60. 81. 158.**

Nookachamps Creek (10)

Loc: Sec. 22, (34-5E). **Ore:** Nickel. **Ore min:** Nickel silicate. **Ref: 158.**

Pacific
(see Mount Vernon)

Powell Creek (5)
Loc: Sec. 2, (35-5E), on Powell Cr., NW. of Minkler. **Ore:** Nickel. **Ore min:** Nickel silicate. **Ref: 158.**

Scott (6)
Loc: Near center sec. 5, (34-5E). **Access:** On road about 2 mi. E. of Clear Lk. **Ore:** Nickel. **Ore min:** Nickel stain, pyrite. **Gangue:** Quartz, carbonates. **Deposit:** Exposure of silica-carbonate rock 25 ft. wide in a road cut. Green nickel stain on weathered surfaces and along joints. **Assays:** Said to run 0.25% Ni. **Ref: 158.**

Sedro Woolley
Loc: Near Sedro Woolley. **Ore:** Nickel reported. **Ref: 130,** p. 84.

Stephens (Cultus Mountain, Boschert) (8)
Loc: NE¼SE¼ sec. 16, (34-5E), on W. slope of Cultus Mtn. **Elev:** 2,000 ft. **Access:** ⅓ mi. by road and 900 ft. by trail SE. of the Northwest Talc & Magnesium Co. pit. **Prop:** State land. **Owner:** Leased by James Stephens, Seattle, Wash. (1942). **Ore:** Nickel. **Ore min:** Green stain, magnetite, pyrite (?). **Gangue:** Serpentine, talc, brucite (?). **Deposit:** Mass of serpentine fractured and crushed and impregnated by green nickel stain. **Dev:** Open cuts. **Assays:** 7 samples with total length of 47 ft. av. 0.32% Ni. **Ref: 158.**

Walker Valley (11)
Loc: NE¼ sec. 33, (34-5E), on W. slope of Cultus Mtn. **Access:** About 1 mi. from Walker Valley on road up Cultus Mtn. **Ore:** Nickel. **Ore min:** Magnetite. **Deposit:** Road cut exposes a zone of crushed serpentine 100 ft. wide. Also considerable float in the area to the N. and E. **Assays:** 3-ft. sample showed 0.23% Ni. **Ref: 158.**

Wilson
(see McMyrl-Wilson)

SNOHOMISH COUNTY

Anderson (5)
Loc: Near N. line sec. 4, (29-7E), about 4 mi. SE. of Granite Falls. **Owner:** Vern Anderson, Tacoma, Wash. (1951). **Ore:** Nickel. **Ore min:** Nickel silicate. **Gangue:** Silica-carbonate. **Deposit:** "Nickel ledge" type of deposit. **Dev:** Open cut, short adit. **Assays:** One sample showed 1.96% Ni. **Ref: 158.**

Asbestos (3)
Loc: On Bald Mtn., on the divide from which Deer, Marten, and Clear Creeks all spring, about 3 mi. NW. of Silverton. Probably in sec. 2, (30-9E). **Prop:** 6 claims. **Owner:** R. C. Myers and Louis Callihan (1897). **Ore:** Nickel, cobalt. **Gangue:** Associated with talc and asbestos. **Ref: 63,** pp. 18, 21.

Blue Bird (1)
(see under gold)

Florence Rae (Rudebeck-Florence Rae) (10)
(see under copper)

Granite Falls (4)
Loc: Center W½ sec. 33, (30-7E), E. of Menzel Lk. **Elev:** 500 ft. **Access:** 3 or 4 mi. SE. of Granite Falls by road. **Prop:** Deeded land. **Owner:** Blake Timber Co. (1942). **Ore:** Nickel, mercury. **Ore min:** Garnierite, genthite, cinnabar. **Gangue:** Quartz, carbonates. **Deposit:** Silica-carbonate rock at least 25 ft. thick and exposed for 2,000 ft. **Dev:** 35-ft. crosscut. **Assays:** 2 samples totaling 8 ft. av. 0.25% Ni. **Ref: 158.**

Hancock (11)
(see under copper)

Little Chief (6)
(see under copper)

Mackinaw (8)
(see under copper)

Mountain Cedar (9)
(see under copper)

Non Pareil (13)
(see under copper)

Palmer
Loc: Snohomish County (?). **Owner:** E. B. Palmer, Rt. 3, Arlington, Wash. (1944). **Ore:** Nickel, copper, zinc. **Ore min:** Pyrrhotite, pyrite, chalcopyrite, sphalerite. **Gangue:** Quartz, calcite. **Ref: 158.**

Rudebeck-Florence Rae
(see Florence Rae under copper)

Verd
Loc: Snohomish County (?). **Owner:** Will Verd, Arlington, Wash. (1944). **Ore:** Nickel. **Ore min:** Nickeliferous pyrrhotite. **Gangue:** Basic igneous rock. **Assays:** Probably would assay more than 1% Ni. **Ref: 158.**

Weden Creek
(see Mackinaw under copper)

Wild Rose (12)
(see under copper)

STEVENS COUNTY

A. Anderson (2A)
(see under zinc)

Cedar Canyon
Loc: Cedar Canyon. **Ore:** Nickel. **Ref: 43,** 8/4/94, p. 111.

Daisy
(see Daisy-Tempest under silver)

Daisy-Tempest (7)
(see under silver)

Marcus (5)
Loc: Near E. ¼ cor. sec. 31, (37-38E). **Access:** About 1,500 ft. S. of Marcus on State Highway 22. **Ore:** Nickel. **Ore min:** Nickel carbonates and sulfates, pyrite. **Deposit:** Road cut exposes breccia zone in sheared argillite over an area 100 ft. long by 400 to 500 ft. wide. Breccia resembles silica-carbonate rock. **Assays:** A 5-ft. sample assayed 0.13% Ni. **Ref: 158.**

Morning Star (6)
Loc: Lots 6 and 7, sec. 6, (36-38E). **Access:** On highway about 1½ mi. S. of Marcus. **Prop:** 1 claim. **Owner:** Z. J. Ferrill (1942). **Ore:** Nickel. **Ore min:** Pyrite or pyrrhotite, nickel stain. **Gangue:** Breccia, magnesite. **Deposit:** Strongly sheared and fractured argillites are mineralized along shear planes. The mineralized shear zone is about 5 ft. wide. **Dev:** Exposed in road cuts. **Ref: 158.**

Mose
Loc: Northport dist. **Ore:** Nickel. **Ref: 107,** vol. 23, 1905, p. 429.

Mullen (4)
Loc: NE¼SW¼ sec. 19, (37-38E), Clugston Cr. area. **Access:** Railroad and highway. **Prop:** 40 acres of deeded land. **Owner:** E. J. Mullen, Chewelah, Wash. (1941). **Ore:** Nickel. **Ore min:** Pyrite. **Deposit:** Vein said to av. 10 to 15 ft. in width. **Dev:** None. Exposed in railroad and highway cuts. **Ref: 30,** p. 78.

Silver Mountain
(see Daisy-Tempest under silver)

Tempest
(see Daisy-Tempest under silver)

Wall Street (1)
(see under copper)

Windfall (8)
(see under copper)

WHATCOM COUNTY

Mount Baker

Loc: Said to be 18 mi. from Glacier in the Mt. Baker dist. **Owner:** Mount Baker Gold, Copper & Tin Co. (1909). **Ore:** Nickel. **Deposit:** Ore said to occur in limestone. **Assays:** Reportedly 2% to 4% Ni. **Ref: 114,** 6/09, p. 88. **158.**

Yellow Aster (1)

Loc: E. side of Yellow Aster Butte, Mt. Baker dist. **Elev:** 4,850 to 5,725 ft. **Access:** Trail about 6 mi. from road. **Owner:** L. C. Huntington, R. A. Griger. (1922). Mount Baker Gold, Copper & Tin Co. (1909-1918). **Ore:** Nickel, gold, silver. **Ore min:** Nickel silicate, magnetite, pyrite, azurite, chalcopyrite. **Gangue:** Quartz, ankerite, magnesite. **Deposit:** "Nickel ledge" 50 to 75 ft. wide, 2,800 ft. long, and at least 875 ft. deep in serpentine and gabbro. **Dev:** Adit 80 ft. long, open cuts. **Ref: 1,** 3/17, p. 84. **98,** 1918, p. 111. **114,** no. 5, 1909, p. 87. **158.**

YAKIMA COUNTY

Indian Creek (1)
(see under mercury)

Wildcat Creek (2)
(see under mercury)

PLATINUM

Properties—Platinum is a silver-gray lustrous metal which is tenacious, malleable, and ductile. It is very heavy and moderately hard. The metal takes a very high and permanent polish. It has a high melting point and low vapor pressure, is a poor conductor of heat and electricity, and has a low coefficient of linear expansion, approximately equal to that of glass. The metal has a high-temperature coefficient of electrical resistivity and has high resistance to spark erosion. It is relatively inert chemically, being highly resistant to corrosion and oxidation; it does not tarnish on exposure to air and is not affected by single mineral acids. Other properties are shown in the table on page 12.

Uses—For many years about half the platinum used in this country has gone into jewelry. Lesser amounts are used in about equal parts in dentistry, electrical apparatus, and chemical industries. The metal and its alloys are used in thermocouples, resistance thermometers, electrodes, electrical contacts, acidproof containers, and laboratory apparatus. It is used as a catalyst in manufacturing high octane gasoline, some acids, and other important chemicals. Minor uses are for pen nibs and for spinnerets for glass fiber and rayon spinning. Platinum compounds have limited uses for platinum electroplating, photographic paper, platinum mirrors, fluorescent screens for X-ray work, etching zinc, and in ceramics.

Production—The United States yearly production of platinum has always been less than one-tenth of the world production and is only a small part of domestic consumption. Alaska has a considerable output of crude platinum, and a small amount is produced as a byproduct of placer-gold operations in California, but much of the domestic production is a byproduct of copper and gold smelting and refining. A very small production of platinum was reported in Washington in 1904, and intermittent small production up to 1934 totaled probably no more than 25 ounces, all as a byproduct of placer-gold mining

Prices—Until 1902, platinum sold for only $4 to $6 per fine troy ounce. The price then began a rise which reached $48 by 1913, and during World War I it reached a high of $154.23 per ounce. Since that time the price has fluctuated between wide limits. After being held by government order at $35 per ounce during World War II it rapidly rose to $90 in 1946, then rose and fell repeatedly in the next 6 years, the price at times being as low as $56 and at other times as high as $103, the highest since 1927. The 1953 price varied between $90 and $93 per ounce. In June 1955 the price was $78 per ounce. The prices quoted are for refined metal; the prices for crude platinum vary with the amounts of the different platinum-group metals present, and are usually substantially below the price for the refined metal.

Ore minerals—The principal source of platinum is natural alloys with one or more of the other members of the platinum group—iridium, osmium, palladium, rhodium, and ruthenium—and with copper and iron. Other than the native alloys, only three platinum minerals are known—the arsenides, sperrylite, $PtAs_2$, and cooperite $Pt(As,S)_2$, and the sulfide, braggite, $(Pt,Pd,Ni)S$.

Geology—Platinum is widely distributed over the world, but in only a few places is it sufficiently concentrated to be recovered commercially. Most primary platinum is intimately associated either with nickel or chromite in deposits formed by magnetic processes in ultrabasic rocks such as peridotite, pyroxenite, and their metamorphosed equivalent, serpentine. The platinum in placer deposits was derived from rocks of this type.

OCCURRENCES

The map showing the numbered platinum occurrences is plate 18, on page 47 in volume 2.

CHELAN COUNTY

Leavenworth Placer

Loc: Presumably near Leavenworth. **Ore:** Platinum. **Deposit:** Sample submitted by M. T. Hurst, Leavenworth, Wash. **Assays:** Two very small particles of platium from a cleanup. **Ref: 12** p. 10.

Mad River Placer (1)

Loc: Reported on Mad R. **Ore:** Platinum. **Deposit:** Place **Prod:** Said to have produced some platinum. **Ref: 67,** p. 4 **126,** p. 10. **130,** p. 85. **141,** p. 103.

Silver Mountain
(see Daisy-Tempest under silver)

Tempest
(see Daisy-Tempest under silver)

Wall Street (1)
(see under copper)

Windfall (8)
(see under copper)

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(see under mercury)

Wildcat Creek (2)
(see under mercury)

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Occurrences

The map showing the numbered platinum occurrences s plate 18, on page 47 in volume 2.

CHELAN COUNTY

Leavenworth Placer

Loc: Presumably near Leavenworth. **Ore:** Platinum. **Deposit:** Sample submitted by M. T. Hurst, Leavenworth, Wash. **Assays:** Two very small particles of platium from a cleanup. **Ref: 126,** p. 10.

Mad River Placer (1)

Loc: Reported on Mad R. **Ore:** Platinum. **Deposit:** Placer. **Prod:** Said to have produced some platinum. **Ref: 67,** p. 47. **126,** p. 10. **130,** p. 85. **141,** p. 103.

Nigger Creek Placer (2)
Loc: 6 mi. above the mouth of Nigger Cr. **Ore:** Platinum. **Deposit:** Found in stream gravels by Division geologists in 1942. **Prod:** Small amount reported. **Ref: 46,** p. 47. **126,** p. 10. **141,** p. 103.

CLALLAM COUNTY

Cedar Creek Placer (4)
(see under gold, placer)

Lovelace Placer
(see Shi Shi Beach Placer under gold, placer)

Ozette Beach Placer (2)
(see under gold, placer)

Shi Shi Beach Placer (1)
(see under gold, placer)

Starbuck Placer
(see Cedar Creek Placer under gold, placer)

Sunset Creek Placer (5)
(see under gold, placer)

Yellow Banks Placer (3)
(see under gold, placer)

CLARK COUNTY

McMunn Placer (1)
(see under gold, placer)

FERRY COUNTY

La Fleur
(see Walla Walla under copper)

Rogers Bar Placer (2)
(see under gold, placer)

Walla Walla (1)
(see under copper)

GRAYS HARBOR COUNTY

Moclips Placer (1)
(see under cerium)

KITTITAS COUNTY

China Camp Placer
Loc: On Cle Elum R. **Owner:** Theodore Cooper, James Wright, John Lind (1897). **Ore:** Platinum, gold. **Deposit:** Low bar, placer. **Prod:** $400 in coarse gold in 1895. **Ref: 63,** p. 66.

OKANOGAN COUNTY

Little Mount Chopaka (1)
Loc: On Little Mt. Chopaka. **Ore:** Platinum reported. **Ref. 141,** p. 103.

Okanogan
(see under chromium)

Oro Fino
(see under gold)

Riverside Placer (3)
Loc: Near Riverside. **Ore:** Platinum. **Deposit:** Samples of placer conc. sent to the U. S. Geol. Survey (1916). **Assays:** "Placer conc. contained a considerable proportion of platinum." **Ref: 97,** 1916, p. 11. **126,** p. 10. **141,** p. 103.

Similkameen River Placer (2)
Loc: Similkameen R. **Ore:** Platinum. **Prod:** Small amount reported. **Ref: 126,** p. 10. **130,** p. 85.

Slate Creek Placer
Loc: Slate Cr., Similkameen dist. **Ore:** Platinum. **Ref: 141,** p. 103.

PACIFIC COUNTY

Beards Hollow Placer (1)
Loc: On ocean beach at Beards Hollow. **Ore:** Platinum. **Deposit:** Black sand. **Assays:** 436 lb. magnetite, 524 lb. ilmenite, 4 lb. zircon, 0.193 oz. platinum per ton. **Ref: 38-A,** pp. 1218-1219. **126,** p. 15. **141,** p. 103.

SKAGIT COUNTY

Anacortes (2)
(see under chromium)

Cypress (1)
Loc: Cypress Is. **Ore:** Platinum. **Deposit:** Platinum is reported to occur in some of the chromite in amounts from 0.006 to 0.245 oz. per ton. **Ref: 123,** p. 65.

SKAMANIA COUNTY

Primary Gold (1)
(see under gold)

SNOHOMISH COUNTY

Le Roy (1)
(see under silver)

POTASSIUM

Properties — Potassium metal is silvery white and bright when freshly cut but quickly oxidizes on exposure to air, the oxidization being rapid enough to cause the metal to catch fire spontaneously in air. It is lighter than water, ductile, malleable, and almost as soft as wax at ordinary temperatures but becomes brittle at low temperatures. It is harder than sodium but softer than lead. It is a good conductor of heat and electricity, its electrical conductivity being exceeded by that of only three or four other metals. Potassium is one of the most active metals chemically, and its chemical properties are similar to those of sodium. It is univalent in its compounds, and, except for the silicates, most potassium salts are water soluble. The metal decomposes water with explosive violence and must be kept under a liquid containing no oxygen, such as petroleum. Alloys of potassium and sodium are liquid at room temperatures. Other properties are shown in the table on page 12.

Uses—Potassium metal is rarely found outside of chemical laboratories. Because of its softness and extreme chemical reactivity, the metal is not suitable for the structural or mechanical uses characteristic of ordinary metals, so uses of potassium metal are based on chemical rather than physical properties. It can be used in synthesis of inorganic potassium compounds, but these compounds ordinarily are not made from the metal but from other potassium salts. The metal can also be used in organic synthesis involving condensation, dehalogenation,

reduction, and polymerization reactions, but there are few, if any, commercial uses for which sodium, which is cheaper, is not equally satisfactory. Potassium salts have a great variety of uses, but more than 90 percent of the consumption is in the form of agricultural fertilizers.

Production—In 1950 there were seven plants producing potash (potassium salts) in the United States, but little, if any, potassium metal was being made. One plant was producing the metal in this country in 1931, but at that time most of the small amount produced in the world came from Germany. No potash or potassium metal has ever been produced in Washington.

Ore minerals and geology—Potassium constitutes 2.7 percent of the earth's crust, and is found in rocks, soils, sea water, and organic matter. It has worldwide distribution in the form of silicate minerals such as orthoclase, zeolites, leucite, and mica, but production has been almost entirely of soluble salts, some of the most important of which are carnallite, $KCl \cdot MgCl_2 \cdot 6H_2O$; polyhalite, $K_2SO_4 \cdot MgSO_4 \cdot 2CaSO_4 \cdot 2H_2O$; sylvite, KCl; and kainite, $MgSO_4 \cdot KCl \cdot 3H_2O$. These salts accumulated as thick beds of marine evaporites, as playa deposits, and as brines of saline lakes. The evaporites have furnished the bulk of the material mined, and they carry up to about 35 percent K_2O. The potassium-aluminum sulfate, alunite, $K_2Al_6(OH)_{12}(SO_4)_4$, contains 11.4 percent K_2O; and should the recovery of aluminum from this mineral—now only in a state of experimental development—ever be put on a commercial basis, potassium might be recovered as a by-product.

Occurrences

Saline lakes in Washington contain some potassium in their brines, but in such small amounts as to preclude their commercial development as a source of potassium. Alunite occurrences in King and Pierce Counties near Enumclaw are described in Part I of this report.

SELENIUM

Properties—Selenium is a semi-metallic element in the sulfur group. Its compounds resemble very closely those of sulfur, and, like that element, it occurs in several different allotropic forms—crystalline, metallic, and amorphous. The crystalline form is red, and the amorphous variety is a dark-red to black powder. The metallic form is lustrous and steel gray and is the most stable form. It has only slight electrical conductivity, but when exposed to bright light its conductivity increases by as much as 100 times. The element has valences of 2, 4, and 6. Most of its compounds are poisonous, and certain plants growing in soil rich in selenium will take up enough of the element from the soil to render the plants poisonous to cattle. Other properties are shown in the table on page 12.

Uses—In 1950 the most important uses for selenium were in the electrical industry, followed by the glass, rubber, ferroalloy, and pigments industries. The important electrical uses are in selenium rectifiers and in photoelectric cells. Large quantities are used in small percentages to eliminate the green color which iron imparts to glass, and when added in larger percentages it produces pink and ruby glass. Likewise, it is used in pigments for other ceramic products and for rubber. Other uses in rubber are as a substitute for sulfur in certain heavy-duty rubber products and in vulcanizing synthetic rubber. Selenium is added in small percentages to some stainless steels, copper alloys, and invar, where it produces free-machining qualities without impairing noncorrosion properties. As a coating on magnesium alloys it prevents corrosion by sea water. Small quantities of selenium compounds are used in antifouling paint for ship bottoms, as an ingredient in lubricating oils, in photography, insecticides, frothers for flotation treatment of ores, as flameproofing for fabric covering on wires, and as a powerful solvent.

Production—United States production of selenium comes from the electrolytic copper refineries in Maryland and New Jersey, and averaged about 500,000 pounds per year for the period from 1940 to 1950. Recovery of the element from refinery slimes is difficult, so only enough to satisfy the demand is recovered. Production could be increased readily if the demand should warrant it. No elemental selenium has been produced in Washington, but sodium selenite is recovered as a byproduct at the copper smelter of the American Smelting & Refining Co. at Tacoma.

Prices—The price of selenium remained near $2 per pound from 1920 to 1950. Black powdered selenium, 99.5 percent purity, sold in New York at $1.75 per pound in 1946, then rose in 1950 to $2, and later in the year to $3.50 per pound. By the end of 1953 the price had risen to $4.25 per pound, and in June 1955 it was up to $6.00.

Ore minerals and geology—Selenium is widely distributed, but is never mined for itself alone. It occurs in association with volcanic sulfur and the sulfides, especially pyrite and chalcopyrite. In the form of the selenides of copper, silver, mercury, lead, bismuth, and thallium it is a minor constituent in many important copper-silver-gold and copper-nickel ore bodies. It has been recovered from flue dusts collected in the production of sulfuric acid from pyrite, and also from sludges at electrolytic copper refineries. Blister copper produced in this country carries from 0.03 to 0.14 percent selenium. In Washington only two selenium-bearing minerals have been identified, and both of these occur in the Knob Hill mine at Republic in Ferry County. These are the copper selenide, umangite, Cu_3Se_2, and the silver selenide, naumannite, Ag_2Se.

Occurrences

The map showing the numbered selenium occurrences is plate 18, on page 47 in volume 2.

FERRY COUNTY

Blaine Republic
(see Republic under gold)

Flag Hill (2)
(see under gold)

Golden Valley
(see Valley under gold)

Lamefoot
(see Valley under gold)

Republic (3)
(see under gold)

Valley (1)
(see under gold)

SILICON

Properties—Although silicon is ordinarily classified as a nonmetallic element, it does possess some metallic properties, and the pure element is commonly called "silicon metal." Massive silicon is crystalline, lustrous, gray black, and metallic appearing. It is brittle and is harder than glass. It is classified as a semi-conductor; that is, it has only slight conductivity for electricity. Silicon has poor mechanical properties, thus it presents a challenge to metallurgists to adapt it to structural uses in order to utilize such desirable characteristics as light weight (lighter than aluminum), corrosion resistance, high melting point, and ease of production. Silicon is almost inert chemically at low temperatures but is active when heated. It closely resembles carbon in its chemical properties and always displays a valence of 4. Other properties are shown in the table on page 12.

Uses—The use of silicon, mostly in the form of ferrosilicon, in making steel is of utmost importance, silicon being used in about 90 percent of the steel made in this country. Normally, just enough silicon is added to each melt to act as a deoxidizer and degasifier, but sometimes enough is added to make silicon-steel alloys, the latter use accounting for about 10 percent of the silicon consumed in this country. Silicon also is used as a scavenger and as an alloy constituent with copper and aluminum alloys. Silicon is used as a heat- and corrosion-resistant coating on other metals, and the pure material is used in transistors, rectifiers, and other electrical equipment. Silicon compounds have many important industrial uses, but few, if any, of these compounds are made from metallic silicon.

Production—In Washington ferrosilicon is produced in electric furnaces at three plants, those of the Keokuk Electro-Metals Co. at Rock Island, the Ohio Ferro-Alloys Co. at Tacoma, and the Pacific Northwest Alloys, Inc. at Mead. Of these, the first two have produced metallic silicon also.

Prices—Silicon of 97 percent purity sold at 20 cents per pound in 1951; in August 1952 the price dropped to 18½ cents, and was still at that figure 3 years later. One pound of extremely pure silicon for electrical use was imported in 1950, and the quoted value was $517 per pound. Material of similar purity was quoted at $430 per pound in 1952.

Ore minerals and geology—After oxygen, silicon is the most abundant element and makes up nearly 28 percent of the earth's crust. With the exception of the carbonates, all the common rocks of the earth's crust are siliceous. Although the element is very abundant, it never occurs free but always in combination in a great variety of minerals, mostly silicates, such as feldspars, amphiboles, pyroxenes, micas, and clays. However, the oxide, quartz is the most abundant of all the silicon minerals, and it is the only mineral which serves as an ore of silicon. In spite of the abundance and widespread distribution of quartz, there are few deposits of the mineral suitable as ore of silicon or ferrosilicon. Ore specifications are hard to meet in that they call for extremely high silica content, low iron, phosphorus, and calcium, and for unusual physical properties.

Occurrences

Occurrences of massive quartz, the principal ore of silicon, are described in Part I of this report. Also in Part I are descriptions of occurrences of quartzite, some of the most pure of which have been mined for the manufacture of ferrosilicon and which might conceivably be mined as ore of silicon.

SILVER

Properties—Silver is a pure-white metal having a brilliant, perfect metallic luster. It is a little harder than gold, and is exceeded only by gold in ductility and malleability. Polished silver reflects visible light as well as, or better than, other metals, is a good reflector of infrared radiation, but is inferior to aluminum and many other metals as a reflector of ultraviolet light. Silver is the best of the metals as a conductor of heat and electricity. The molten metal in air dissolves 22 times its own volume of oxygen, which, when the melt cools, escapes with a sputtering sound and a flash of light. Silver is not ordinarily oxidized by air, and resists attack by many chemicals, but it tarnishes readily when contacted by sulfur compounds. The element is univalent. Other properties are shown in the table on page 12.

Uses—Silver has been used since earliest times for coins and ornamental articles, and the largest use is still for monetary purposes. Much of it is simply hoarded,